

Firm size distribution in Italy and employment protection

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The number of Italian firms in function of the number of workers shows a clear downward deflection in correspondence of 15 workers, both when using old pre-1999 data and when using recent (2014) data. This phenomenon could be associated with employment protection legislation which applies to companies with more than 15 workers (the Statuto dei Lavoratori). The deflection disappears for agriculture firms, for which the protection legislation applies already above 5 workers. In this note it is estimated that a correction of this deflection could bring an increase from 3.9 to 5.8% in new jobs in firms with a workforce between 5 to 25 workers.

I. INTRODUCTION

The average number of workers per company in Italy is much lower than the EU average: 3.9 versus 6.1 [1]. This relative smallness of Italian firms is often seen as one of the causes of the weakness of the Italian economy in the global markets. One hypothesis that has been advanced to explain the phenomenon is that the Italian legislation makes it costly for a company to grow to over 15 workers because above this threshold the legislation known as the Statuto dei Lavoratori (Worker’s Statute) applies. This includes, in particular, the restrictions on firing workers with open-ended contracts (the so-called Art. 18). In the case of agriculture firms, the Statuto applies already above 5 workers. The strong financial compensation to the fired employee enforced in some cases by the Art. 18, in addition to the risk of a forced reinstatement and a long legal litigation, could lead some companies to choose to remain undersized [2]. A concise and clear history of the employment protection in Italy can be found in [10] and will not be repeated here.

In order to test the hypothesis that the Statuto limits the growth, we analyse here three sets of data, one obtained by an average over the years 1986-1999 for all the Italian private firms between 5 and 25 workers (we denote it as pre-1999 data, [3]) and two for year 2014 [11] for the same workforce range. The 2014 data has been collected separately for agriculture firms (we denote this dataset as Agri2014 data) and for the rest (we denote this as 2014 data) in order to further test the effect of the threshold at 15 workers. Some global figure about the three datasets are reported in Tab. I In all cases the workforce includes open-ended as well as temporary workers at the time of the recording. The definition of agriculture firms in the Agri2014 data is not completely equivalent to the legal definition for as concerns the Statuto so the Agri2014 data for firms above 15 workers might be contaminated by an unknown number of firms that are actually subject to the Statuto provisions; what is important for the present analysis, however, is that all the firms with more than 15 workers in the 2014 dataset are subject to the Statuto. For the pre1999 data, the agriculture firms are included in the dataset. As one can see from the relative numbers in Tab. I however, the fraction of the agriculture firm should be rather small.

The pre1999 and the 2014 datasets are shown in Fig. (1) in logarithmic coordinates. Denoting with \( n(A) \) the number of firms with \( A \) workers, we show on the ordinate the total number \( A \cdot n(A) \) of workers in firms with \( A \) workers. The trend appear quite similar, a part for the absolute values. In both cases, an initial straight line (i.e. an inverse power law) gives way near 15 workers to a quite steeper downward curve, which is also as a first approximation an inverse power law. In Fig. (2) we compare instead the 2014 data with the Agri2014 data, rescaled by an arbitrary factor 12 in order to bring them closer to the 2014 data. As it appears quite clearly, the Agri2014 data do not show any obvious departure from a straight line, although they have a much larger scatter due to their smaller absolute values. The visual inspection of Figs. (1) and (2) seems therefore to support our initial hypothesis. The rest of this paper is devoted to test it quantitatively and to extract some possible estimate of how many jobs the removal or attenuation of the provisions of the Statuto could induce.

II. THE PRE-1999 DATA

In a work of Schivardi and Torrini in 2008 [3], the pre-1999 data for the roughly 250,000 Italian companies active in the period 1986 to 1998 has been analyzed. The average \( n(A) \) of the number of firms as a function of the number of workers is shown in Fig. (3) in log-log coordinates. The authors of Ref. [3] find that the effect of the downward turn around 15 workers is statistically significant but is relatively small and its removal would bring only a 0.5% to 1% increase in jobs. This result was obtained by estimating the probability of firms to

<table>
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<th>Approx. Workers</th>
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<td>2014</td>
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<td>3,401,000</td>
</tr>
<tr>
<td>Agri</td>
<td>21258</td>
<td>193,000</td>
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Table I: Firm data
The behavior of firms before and after the threshold can be corrected by estimating what the distribution has been ascertained also in [10]. Given the existence of a statistically significant change around 15 workers is confirmed independently of the hypothesis that it is caused by legislation. This implies that the firm distribution shows a discontinuity in its first derivative rather than in the distribution itself (the continuity of the distribution has been ascertained also in [10]). Given the existence of a statistically significant break, one should fit separately the trend below and above threshold. To this aim, we employed the RANSAC algorithm [12], which consists in a search of a best fit composed of two independent straight lines on the log-log plane \( \log n, \log A \). In all the simulations performed with various probability threshold (points farther than 2 or 3\( \sigma \) are rejected from the consensus fit), the intersection between the two lines has always been correctly identified in the vicinity of 15 workers and most of the points upstream and downstream of the threshold have been assigned to the two different power laws. The existence of a statistically significant change around 15 workers is thus confirmed independently of the hypothesis that it is caused by legislation.

The curve for \( A = 5 - 15 \) appears to be very well described by a power law (Pareto distribution) obtained by the method of least squares

\[
n_{fit}(A) = 10^{5.838\pm0.006}A^{-1.645\pm0.007}
\]

This estimate includes Poisson errors in the number of firms, \( \Delta n/n = 1/\sqrt{n} \), although the effect of the errors is negligible (they would appear smaller than the symbols used in Fig 3). The data for \( A > 16 \) lie systematically below the power law. The slope of the best fit is \( -1.645 \) for \( A = 5 - 15 \), steepens to \( -2.34 \) if one fits in the range \( A = 16 - 25 \) and is \( -1.82 \) if one fits the entire sequence; a power law fit applied to the entire sequence does not appear, however, statistically acceptable.

A similar effect was found in France near the threshold of 50 workers, beyond which a number of protective
France (with a break around 50 as mentioned), in our good approximation to firm distribution in the US, in the fact that indeed a power law has been found to be imposed is a power law. This hypothesis is based on of firm sizes when no artificial restriction on growth are hypothesis (to legislation or not. To do so we make a first crucial causes of the change in slope, whether they are associated so the comparison is not straightforward. There are however other thresholds at 10 and 20 workers one would obtain if the change in slope could be removed.

We can now try to estimate the effect of removing the causes of the change in slope, whether they are associated to legislation or not. To do so we make a first crucial hypothesis (power-law hypothesis): that the distribution of firm sizes when no artificial restriction on growth are imposed is a power law. This hypothesis is based on the fact that indeed a power law has been found to be a good approximation to firm distribution in the US, in France (with a break around 50 as mentioned), in our own data separately below and after the break at $A = 15$. Even where a small deviation from a power law over large size intervals has been observed, for instance in Dutch manufacturing firms, a power law approximation looks very reasonable in the range below 25 workers.

Once the shape of the trend is fixed, we are left with just two parameters, normalization and slope. Since we are trying to forecast a redistribution of firms regardless of their birth or mortality rates, we will assume that the number of firms remain constant after the barrier removal. This leaves a single parameter to fit, either the slope or the normalization or a combination thereof. Next, we make a second crucial assumption, to be referred to as the growth hypothesis, namely, that the number of small firms will not increase in number as a consequence of the barrier removal. This seems very reasonable, since it would be rather hard to explain why the number of small firms should increase when a barrier to growth has been removed. One could argue perhaps that the current legislation is also a barrier to decrease, because it forces the firms to retain workers that would otherwise be fired. This explanation is however untenable, first because a firm could anyway reduce its employment by simply ceasing the natural turn-over and secondly because a firm will anyway fire its workers if the financial conditions require it, or else it would fail. If we assume then that the small firms do not increase in number, then there are only two possible limiting scenarios, that now we discuss in turn.

In the first scenario (let us call it fixed-slope scenario), we can assume that the firms with less than 15 workers have been currently growing unimpeded as long as they stayed below 15 workers. If this were the case then, by removing the barrier, the behavior observed below 15 workers would extend to above the threshold. If in addition as already emphasized we keep constant the number of firms, then the after-removal behavior would be represented by an extrapolation of the same $-1.645$ power law to $A = 25$ accompanied by a rescaling to match the total number of firms. Then we could estimate an additional number of workers among firms with $A > 15$ equal to the area between the best fit and the observed data of Fig. accompanied by a decrease of firms and therefore of workers employed in firms below threshold. If we denote by $n(A_i)$ the number of firms with $A_i$ workers, we obtain an estimate of an additional number of workers equal to

$$
\Delta A_{tot} = \sum_{i=5}^{25} A_i [n_{fit}(A_i) - n(A_i)] \approx 130,000 \pm 5000
$$

where $\alpha \approx 0.95$ takes into account the rescaling needed so that the total number of companies is kept equal to the original one. The number of additional workers represents about 5% of the total two and a half million workers of the pre-1999 sample. The number of companies with 25 workers would increase from about 2100 to about

![Figure 3: The dots represent the number of firms as a function of the number of workers (elaboration of data from Ref. [3]). The dashed line indicates the best fit from 5 to 14 workers (blue circles). Subsequent points (red squares) differ significantly from the extrapolated behavior. The continuous line is obtained by rescaling the best fit in order to provide the same total number of companies (fixed-slope scenario).](image3)

![Figure 4: Total number of workers per worker bin. As in Fig. 1, the dashed line indicates the best fit from 5 to 15 workers (blue circles). The continuous line is obtained by rescaling the best fit in order to provide the same total number of companies (fixed-slope scenario). The grey region denotes the total number of new workers in firms above 15 workers, virtually identical to what is obtained by rescaling the best fit in order to provide the same total number of companies (fixed-slope scenario). The grey region denotes the best fit from 5 to 14 workers (blue circles). Subsequent points (red squares) differ significantly from the extrapolated behavior. The continuous line is obtained by rescaling the best fit in order to provide the same total number of companies (fixed-slope scenario). The grey region denotes the best fit from 5 to 14 workers (blue circles). Subsequent points (red squares) differ significantly from the extrapolated behavior. The continuous line is obtained by rescaling the best fit in order to provide the same total number of companies (fixed-slope scenario).](image4)
3200. We are of course making the tacit assumption that there is no significant shortage of workers to hire. The estimate slightly increases if to stay further away from the threshold we take as natural behavior the trend up to 14 workers (136,000 new jobs) or 13 (139,000 new jobs). These results and the others to be discussed below are summarized in Tab. (III).

In the second, more conservative, scenario (the fixed-normalization scenario), we can assume that the firms with the lowest number of workers would be unaffected by the barrier removal and would stay the same. Then in order to match the total number of firms we should change the slope of the power law. This is obtained by a slope approximately equal to −1.72, i.e. slightly steeper than before. Using this power law as the after-removal distribution, we estimate a number of new workers around 89,000 ± 5000, i.e. 3.6% of the total sample. Notice that this result is not an extrapolation of the below-threshold behavior: it is entirely based on the power-law and the growth hypotheses.

Any other scenario would have either to lie above the fixed-normalization scenarios or to violate one of the two basic assumptions: either it should abandon the hypothesis of a power law, or lead to a number of small firms that increases when the barrier is removed. In other words, given the assumptions, the fixed-normalization scenario produces the most conservative estimate of the number of additional workers while we can take the fixed-slope case as a reasonable upper limit.

III. THE 2014 DATA

We repeated the analysis using the 2014 data, consisting of roughly 357,000 private non-agriculture firms between 5 and 25 workers [11]. Here again the distribution is characterized by two different slopes (see Fig. 5), slightly steeper than for the pre-1999 data: −(1.75 ± 0.006) for \( A = 5 - 14 \) and −2.32 for \( A = 16 - 25 \) (or −2.21 for \( A = 17 - 20 \)). The broken power-law distribution remains qualitatively the same even when decomposing the data along regional units. Using the fixed-slope scenario we estimate 198,000 new jobs, i.e. a 5.8% increase while we obtain 132,000 new jobs (3.9%) with the fixed-normalization scenario. The fixed-slope figure remains practically the same (197,000 jobs) if we employ the fit up to 13 workers. In both cases the error is estimated around 5000 units. See the summary in Tab. (III) for additional cases.

IV. THE AGRICULTURE FIRMS

Contrary to the other cases, the Agri2014 dataset can be fitted by a single power law with slope −(2.19 ± 0.025): the \( \chi^2 \) is 26.9 for 19 degrees of freedom (\( p \)-value 0.1). Adopting the fixed-slope scenario and extrapolating the slope between 5 – 14 workers, we obtain an estimated increase of 1500 ± 1100 jobs, i.e. 0.8 ± 0.6%, which reduces to 0.5 ± 0.5% with the fixed-normalization. This confirms the visual impression from Fig. 2 that the agriculture firms do not show a significant change around 15 workers.

V. FURTHER TESTS

The analysis can be repeated under slightly different assumptions.

The error attributed to the Poissonian counts is probably too optimistic, since it provides a \( \chi^2 \) statistic per degree of freedom for the pre-1999 data in the range \( A = 5 - 15 \) equal to 3.8 (\( p \)-value 0.0001). Increasing the errors by a factor of 1.9 produces a \( \chi^2 \) per degree of freedom equal to about 1. The fit \( n_{fit}(A) \) remains the same but the uncertainty on \( \Delta A_{fit} \) increases slightly from 5000 to 8000. Removing the entry at \( A = 15 \) from the fit, the \( p \)-value increases to 0.02, which could indicate that the \( A = 15 \) entry is slightly anomalous. This is hardly surprising, since it is an average obtained over several years and therefore will include firms that for some time have
been above threshold; moreover, the very definition of “number of workers” has been fluctuating over time and a firm might well decide to stay well below the threshold to avoid legal complications. The same factor 1.9 also brings the linear fit for the 2014 data to a $\chi^2$ per degree of freedom close to unity. Note that since the workforce includes temporary workers at the time of recording, the average number of workers in a firm fluctuates around the given values.

The curve data log $n_i$ vs log $A_i$ in the range $A = 5 − 14$ can be approximated also by a polynomial of higher order rather than by a straight line. With a polynomial of order 2, 3 or 4 we obtain respectively $\Delta A_{tot} = 103000$, 88000, 120000 for the pre-1999 data. Note however that in these cases, assuming Poisson errors, the $\chi^2$ per degree of freedom becomes only 0.5-0.7 and obviously decreases with more realistic (i.e. larger) errors. Higher order polynomials therefore do not seem to be supported by the data in the range $A = 5 − 14$. Higher order polynomial are instead statistically acceptable fits to the 2014 data, but then $\Delta A_{tot}$ is close to or larger than the straight line result (see Tab. II).

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Table II: Summary of results (FS=fixed normalization; FS= fixed slope). The relative error on the number of jobs is around 5% except for the last two rows, where it is around 70-100%.

VI. CONCLUSIONS

From this brief analysis we cannot of course derive in a mechanical way a causal relationship between the broken power law $n(A)$ and the Statuto dei Lavoratori. It is also impossible from this data to establish what other side effects a reform of the Statuto could have, for instance whether it will induce merging of small companies rather than real growth or whether it will modify the employment of temporary versus open-ended workers.

It seems clear, however, that the behavior of firms does change in correspondence of 15 workers. Removing the causes of such behavior, whatever they may be, could generate from roughly 130,000 to 200,000 new workers in our sample, about 3.9-5.8% of the total 2014 sample. These figures are, it should be noted, only a lower estimate, because limited due to lack of data to companies with fewer than 25 workers.

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